Compressed sensing on displacement signals measured with optical coherence tomography: supplement

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1. DETAILS OF WAVELET SPARSITY

In the main text, we present results for reconstructions using the iterative shrinkage thresholding algorithm (ISTA) with a three-level Daubechies-7 (db-7) wavelet transform. We chose this wavelet basis by assessing the sparsity of our signals in several wavelet bases. We then determined the number of levels to use by comparing normalized mean square error (NMSE) results for reconstruction using two-, three- and four-level wavelet transforms.

A. Sparsity in Wavelet Domains

To assess sparsity, we considered the reconstruction of the original areal motion map after hard-thresholding the smallest wavelet coefficients. In particular, we considered the keep probability of coefficients necessary to achieve an NMSE of less than 1% between the original map and the map reconstructed from the thresholded signal.

Figure S1 shows this keep probability for Daubechies 1-20 wavelet transforms. Compression rates of 42 maps are shown, taken from two angles, seven stimulus frequencies and three SPL.

This shows that across viewing angle, frequency and amplitude the signal is sparse in Daubechies 4-20 wavelet domains. Motion maps can be represented faithfully for all maps shown using less than 5% of wavelet coefficients in each of these domains. This makes a strong case for global sparsity in motion within the cochlea in these wavelet domains, including db-7.

B. Difference between Levels

We chose to use a three-level wavelet transform, motivated by the NMSE results of comparing two-, three- and four-level wavelet transforms on the test set ($N = 20$). Fig S2 shows that at $P = 10$, the three-level wavelet transform performs best of the tested methods.
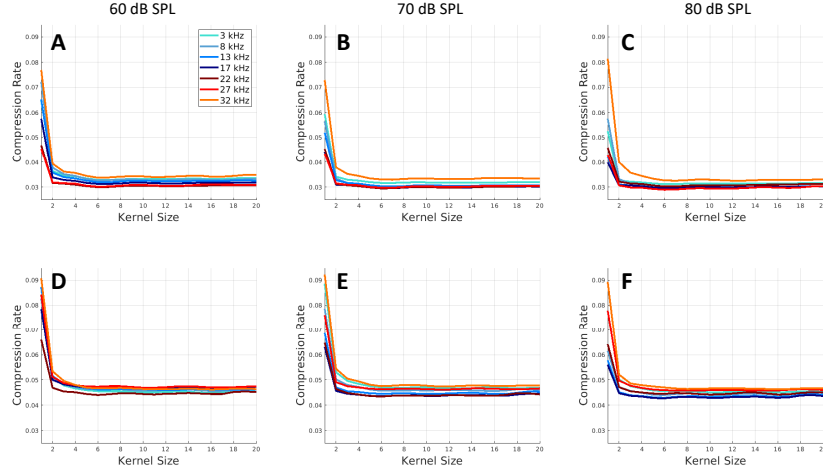
Fig. S1. Compression rates of *in vivo* areal cochlear motion patterns at three stimulus levels, seven stimulus frequencies and two viewing angles. Curves show the proportion of wavelet coefficients needed to achieve 1% NMSE from the original motion map using Daubechies 1-20 wavelet transforms. **A-C**: Compression rates for $\theta = 1$ in response to 60, 70 and 80 dB SPL stimuli, respectively . **D-F**: Same as **A-C** but for motion maps acquired at $\theta = 2$.
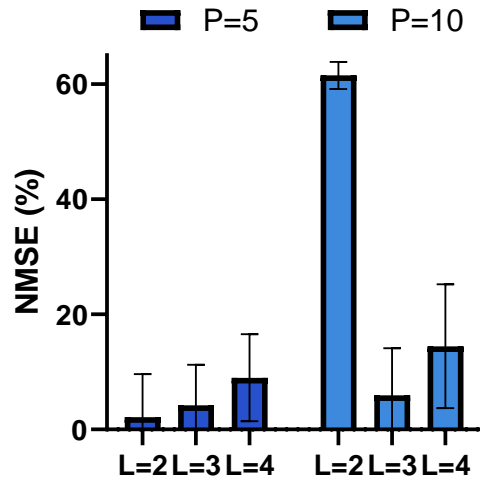

Fig. S2. NMSE for ISTA on the test set ($N = 20$) using two-, three- and four-level (L) Daubechies-7 wavelet transforms at $P = 5$ and $P = 10$.